3. PROBLEM IDENTIFICATION AND DEFINITION

Introduction

More than any of the other three Principles, clear and concise problem definition appears to be a simple statement of the obvious; and in many respects it is. Unfortunately, as environmental restoration has become more common, it has become process oriented and has drifted away from this focus. Practitioners can be observed performing activities prescribed in general guidance irrespective of the presence of a connection between those activities and the objective of the immediate work (i.e., select the appropriate response alternative). As an example, many data collection efforts are justified on the basis that they are needed to characterize the nature and extent of contamination as discussed in the NCP, even though available data are sufficient to provide the core information needed to move forward with a response decision and implementation. In these cases, characterization is being conducted for its own sake with no identified rationale about using the additional data to select between response alternatives. This has led to the seemingly endless phases of investigation with no real progress made with respect to actual cleanup. Similarly, reports identified in the NCP are declared milestones and used to demonstrate progress rather than document completion of specific tasks that entail true progress. The Principles constitute an approach to enhance the environmental restoration process that focuses on objectives and real end points rather than the process itself.

Environmental restoration is driven by two key questions:

- Does a problem exist?
- If one does, what should be done about it?

Principle 2: "Clear, concise, and accurate problem identification and definition are critical" and provide the focus necessary to answer the first of these questions.

Through clear, concise, and accurate problem identification and definition, the PMT creates a standard for evaluating the merits of proposed response actions. The result of applying this Principle is embodied in a problem statement that, when used properly, is a valuable tool for communicating site issues with the public at a level they can understand. The problem as defined in the problem statement is what is scoped, characterized, and ultimately remediated. Hence, it plays the central role in determining what needs to be done and why.

In practice, problem identification is integrated with the other Principles - identifying response actions, managing uncertainty, and creating an effective

PMT. The PMT is ultimately responsible and accountable for problem definition at all levels on which environmental restoration activities occur:

- Installation wide: What is the focus of the overall installation strategy and how should resources be organized to investigate and remediate areas of concern (AOCs)?

- At an operable unit (OU) or group of OUs that share common problems: What are those problems? What is the problem statement for each problem that is identified?

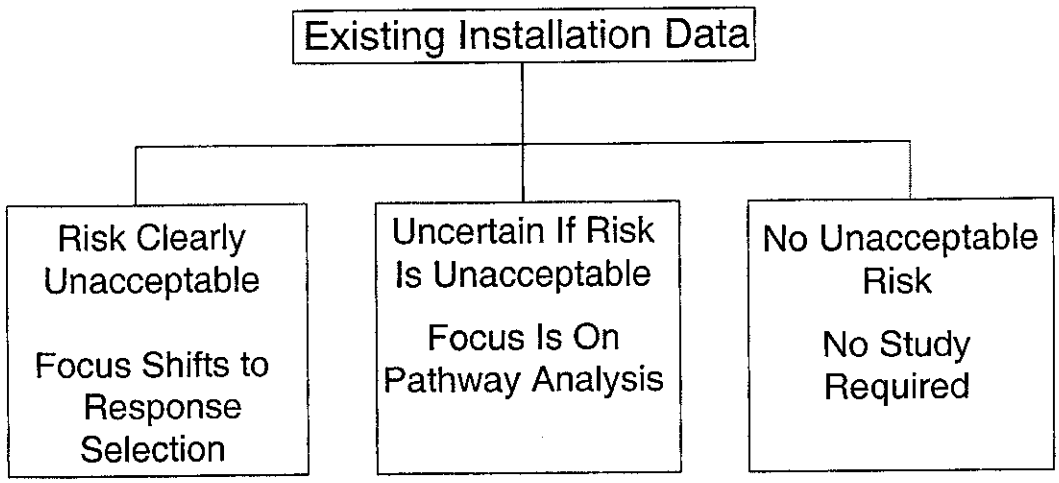
- At an individual release site: What is the condition that requires a response?

This chapter discusses the need to identify the potential problem early, document it in a problem statement consistent with the conceptualization of the site, and structure subsequent activities on the basis of what constitutes necessary and sufficient data to substantiate or refute its existence.

Problem Definition

As mentioned in the previous chapter, it is the responsibility of the PMT to identify and define problems at the installation. As employed herein, a problem is defined as *a situation posing real or potential unacceptable risk, or a condition that requires a response.* A problem may be an unacceptable potential risk to human health or the environment (e.g., evaluations may indicate that a health-based standard has been exceeded at the point of exposure), or a perceived risk (e.g., dioxin observed in soil even if no chance of exposure exists). There are thresholds that define whether a current or potential exposure pathway poses unacceptable risk. However, there are also conditions that regulations, agreements, or public perceptions delineate as unacceptable, regardless of the actual degree of risk posed. For example, underground storage tank regulations require removal or closure in-place of tanks that are not properly protected from corrosion or leakage regardless of whether they pose a risk. As shown in Figure 3-1, this determination should initially start with existing installation data.

Figure 3-1: Focus of Risk-Based Studies



Where remediation is driven by chemical releases that may pose potential or perceived unacceptable risks, there are three categories of releases that should be identified for purposes of focusing data collection:

Category 1: Unacceptable Risk

This category includes releases that clearly exceed risk-based criteria to the extent that remedial action is required in the near term. The first key question has been answered: a problem exists. Any efforts expended to determine nature and extent of contamination should be scoped to address the aspects of nature and extent that will impact selection and design of the remedy. Therefore, data collection should be focused on gathering the information required to answer the second key question on what to do about the problem. These sites are candidates for removal actions if there are limited choices for a response, ongoing exposures, or the potential for substantial cost growth if left unremediated.

Category 2: Uncertain Risk

This category includes AOCs where it is uncertain if releases have occurred at levels that pose unacceptable risk. More data may be required to substantiate a problem. In these cases, the primary objective for data collection will be to identify complete pathways and quantify the source and releases to determine if resultant risk exceeds the threshold of acceptability.

Category 3: No Unacceptable Risk

> This category includes AOCs where it is known that no action is required. This determination should be documented and the site removed from further consideration.

It is Category 2 that poses the greatest challenge to the PMT. Consensus as to whether a response is required often is not reached easily. There may exist situations where there is sufficient uncertainty with respect to the applicability of requirements or the estimated level of risk involved that the PMT cannot determine or agree on whether or not an unacceptable risk exists. The inability to agree on whether a response is warranted does not in itself represent a problem; rather, this represents a data need. Because determining whether an unacceptable risk exists is a critical initial activity for the PMT, investigation activities may be required to fill the data need. However, these activities (i.e., data collection) are not defined as a response action and, until the PMT can reach agreement on a path forward, no problem exists within the meaning of this Principle. **A data need does not equate to a problem.**

Not all uncertainties need to be resolved. Uncertainties with respect to site characteristics, regulatory issues or technology performance are data gaps, but become data needs only when their resolution is fundamental to being able to answer one of the two key questions of environmental restoration. Information needs include data to establish with sufficient certainty that a condition poses a problem (i.e., requires a response), and data necessary to focus on what response action to take. Data gaps not relevant to these fundamental decisions are generally not significant and need not be resolved. Hence, if filling a data gap does not affect how the PMT would respond to the two key environmental restoration questions, the data gap is not likely to be a data need.

Once identified and agreed upon by the PMT, problems consist of one of three types, characterized as follows:

1. Contamination is present above concentrations associated with an unacceptable level of risk;
2. Response is required because of legal requirements or other commitments; or
3. Response can be demonstrated to be less costly than efforts required to determine if a response is required because of risk.

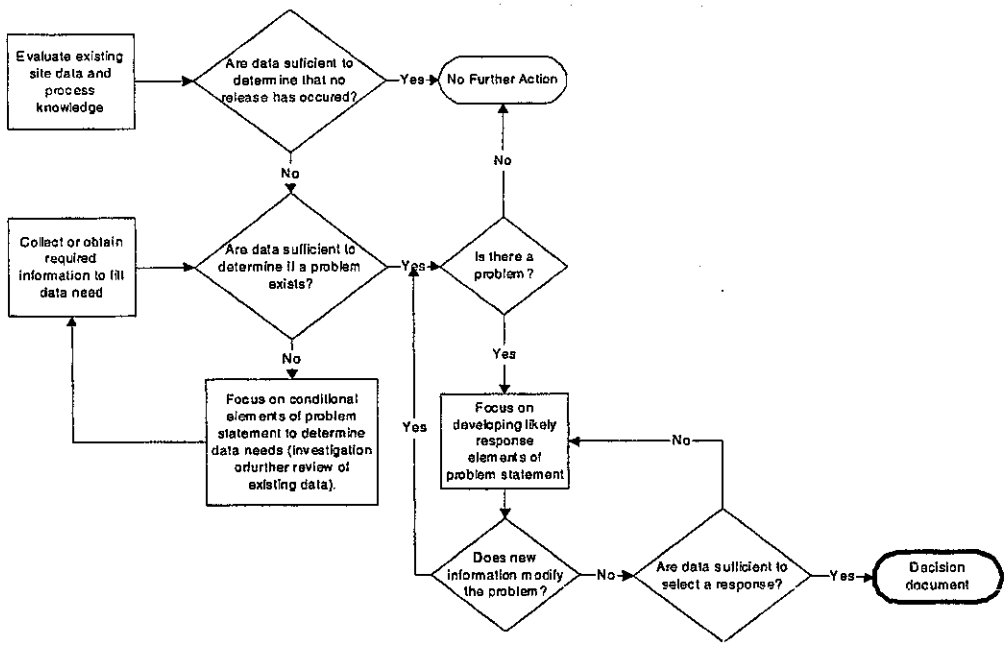
At Army sites, the majority of problems arise from releases of contaminants that pose a potential risk to human health or the environment (i.e., the first type of problem). This is particularly true of restoration efforts being conducted under CERCLA. These problems must be characterized only to the degree sufficient to substantiate a potential unacceptable risk (i.e., demonstrate a problem exists) and evaluate response alternatives.

Other situations requiring response arise because of specific requirements in a permit (e.g., clean closure of a regulated unit, removal of related equipment) or other legal requirements that have not been met (e.g., tank removal, State requirement not based on site-specific risk consideration). This second type of problem is most often encountered when restoration is performed under RCRA or when a State program applies. Often, these requirements are clearly identified and can be accomplished without collecting data to justify no action or alternative actions. Because these responses are not risk-based, there may be no utility in conducting a risk assessment. As such this type of problem should be identified up front so that unnecessary studies are avoided.

Finally, there may be conditions that are not legally required (e.g., owner/operator internal policy) and/or will be more difficult to assess than resolve (e.g., small volume fuel release to surface soil). These situations are characterized as the third type of problem. When these situations are encountered, they should be flagged and addressed before resources are committed to unnecessary studies. Due to fiduciary responsibilities borne by Army staff, taking a response on sites where assessment is being by-passed can not be considered lightly. The PMT must carefully document the cost savings and justification to avoid the perception of having pursued an action arbitrarily.

Sorting through the three types of problems can be addressed most efficiently by sequencing the relevant decisions (Figure 3-2). Once specific legal requirement(s) beyond CERCLA are found to exist, all subsequent work should be focused on meeting the legal requirements, not on assessing risk. Remaining actions should be risk driven unless it is less costly to remove potential risk than to assess it. For these types of problems, the Army addresses its requirement to protect human health and the environment by conducting an evaluation of residual risk after the removal is performed.

Figure 3-2: Decision Logic



Problem Scope

A problem is seldom equal to an OU or an AOC. Multiple problems may exist within these unit definitions, or problems may exist across unit boundaries. For example, OUs may contain multiple types of waste disposal units, contaminants, media, receptors, and potential exposure pathways. Individual problems must be evaluated within the unit under investigation. Likewise, if soil contaminated with a particular contaminant is found throughout several AOCs, a problem can be defined once, then can be applied to all occurrences of the contaminant in the soil (barring any additional receptors or other factors).

Problem definition is the focus because poor problem definition results in poor PMT performance as evidenced by:

- Poor project focus
  - Overly extensive or ineffective investigation (e.g., trying to remove insignificant uncertainties)
  - Extended remedy selection process

- Poor project execution
  - Not fixing the problem

- Fixing a non-problem
- Fixing the problem at greater cost than needed

- Poor project closeout
  - Inappropriate exit strategy
  - Prolonged site closeout
  - Inappropriate or inadequate contingency plans

Problem Statement

Having defined the problem, the PMT must document/communicate the basis for response. A problem statement structured as a decision rule can be an effective tool for communication because it describes the basis for planning the decision-making process. The problem statement is a clear, concise description of the condition that may need a response. It provides linkage to the key decisions that need to be made at any point in time by specifying the condition requiring response, reflecting the current conceptual site model, and evolving as knowledge is gained.

The following are example problem statements.

- Lead is found in excess of the preliminary remediation goal, 400 mg/kg, in the top 2 feet of soil over an area greater than one-quarter acre that is anticipated to be developed for residential use.

- Groundwater quality data confirm contamination beneath the installation above the MCL for TCE while historic practices indicate a strong likelihood that a portion of the contamination is present as DNAPL. Off-site migration is indicated, but not confirmed, and the nature of residual source material in the vadose zone is unknown.

Problem statements define the circumstances that require a response. Key components of a problem statement include media, contaminants and concentrations, volumes, and regulatory or other drivers. Problem definition becomes the "if" part of an "if...then" decision rule. A decision rule includes:

- A statement of the unacceptable risk or condition (i.e., problem definition);

- The action that will be taken;

- When necessary, the data required (or sufficient) to support the decision;

- Decision criterion (action level); and

- Data statistic to be used to make the decision.

The "then" portion of the problem statement cast in a decision rule format addresses the response actions that will be taken as described in Chapter 4.

Decision rules are an accepted manner of linking together problem statements, likely response actions, and data required to support the decision. They clearly communicate how the PMT intends to respond to a given set of circumstances and what thresholds or key factors will lead to taking a specific action (i.e., they summarize the decision logic).

Decision rules are used to document what constitutes sufficient information to make a decision. The initial focus is on the decision of whether to take action (i.e., whether a problem exists). The data required to support this decision may vary widely -- from characterization information, to identification of the concentrations that pose a problem, to input on stakeholder concerns. If adequate information does not exist, it is collected only to the extent necessary and sufficient to allow for a decision to be made.

Necessary and Sufficient Data

In the context of writing the problem statement (the first key question in environmental restoration), necessary data are data that, when obtained, could substantially change the content of the problem statement. Data are not necessary if regardless of their value, the problem statement will not change (i.e., data must have the potential to change a decision about the content of the problem statement before they are necessary). Sufficiency can be defined as the amount of data needed to support the decision to the necessary (agreed upon) level of confidence.

A continuing challenge at AOCs is the identification of the point at which the investigation is sufficient to declare there has been no release (i.e., when to stop collecting data in search of a problem). By definition, there is no investigation of AOCs for which there is no history of release or any reason to believe a release may have occurred. However, there are many examples of PMTs attempting to prove the negative when poor records or anecdotes leave the issue of release in question.

For AOCs where a release may have occurred, samples are collected and analyzed to determine if chemical residues are present. Since there may be residues that do not pose a risk, soil screening levels (SSL) or preliminary remediation goals (PRG) are usually identified as thresholds. If contaminant concentrations do not exceed the threshold, there is no problem. The PMT needs to be able to make that decision without requiring extensive random sampling. Because the initial samples are usually biased (i.e., taken from the likely point of greatest contamination) these samples may generate sufficient information to make the required decision.

By preparing a good problem statement, there is a means of testing to see if proposed activities are necessary and sufficient to get to the point where the best means of resolving the problem can be selected. Once a problem statement can be written, the focus of decisions and, therefore data collection, shifts to what response is appropriate (Figure 3-2).

This Principle applies throughout the environmental restoration program, but is manifested differently depending on the phase of activity being conducted:

- Pre-Decision Document
  - Clear, concise statement of the problem

- Post-Decision Document
  - Clear, concise statement of restoration objective
  - Clear definition of performance measurements that demonstrate response completion

- Post-Construction Completion or Closure
  - Document construction is complete and/or desired end state has been reached

Summary

A problem is a condition that requires a response. Problems are what are scoped, characterized, and ultimately remediated at release sites. For Army installations, most problems are associated with chemical residues from releases that pose unacceptable risk under current or reasonably anticipated future use scenarios. Therefore, it is essential to quickly identify all relevant problems at a site and document them in problem statements as a means of communicating with stakeholders and keeping subsequent efforts focused. Problem statements should be reviewed continually to ensure that proposed actions are consistent with the identified or expected problem and revised as appropriate when new information is obtained.

With transition to the post-decision document phases, the focus on problem evolves to a clear statement of remedial action objectives, performance monitoring goals, and the desired end state.